The Gyrodyne

Dr. Bennett Outlines its History and Describes its Special Features

S/L. Arkell demonstrates the Fairey Gyrodyne's hovering capabilities at Heston airfield.

MEMBERS and friends of the Helicopter Association of Great Britain were the guests of the Fairey Aviation Co., Ltd., at Heston last Saturday, when Dr. J. A. J. Bennett, head of the helicopter branch of the company, gave a lecture on the Fairey Gyrodyne. Afterwards a colour film was shown, which included a few shots from the recent world's record flight, when S/L. Basil Arkell averaged 124.3 m.p.h.

After an interval for tea, S/L. Arkell gave some very convincing demonstration flights on the Gyrodyne. As the machine is still classed as experimental, passengers could not be taken, but an exception was made in the case of Mr. H. A. Marsh, chairman of the Association and manager and test pilot of the Cierva Autogiro Company, Ltd., who flew as a passenger "at his own risk." After the flight Mr. Marsh spoke highly of the smoothness of the Gyrodyne.

Particularly impressive were Mr. Arkell's high-speed flights. One has become so accustomed to seeing helicopters hovering, putting down and taking off vertically, that it was very refreshing to see one moving really fast horizontally, a useful reminder that hovering is not the only asset of the helicopter. The occasion was also a memorable one in the history of the Helicopter Association in that it was the first time a flying demonstration was given after a lecture. It was evident that members and their friends thoroughly appreciated the fact, and the attendance was good in spite of the rival attractions at Gatwick.

A Private Venture

Dr. Bennett began by paying a tribute to the board of the Fairey Aviation Company for their firm belief in the gyrodyne principle from the beginning, and for having sufficient faith in their own judgment to sponsor it entirely as a private venture.

The conception of the gyrodyne, Dr. Bennett said, originated in this country shortly before the war, to fulfil a Naval requirement for a rotary-wing aircraft capable of operating from the deck of a ship. It is true that the possibilities of the gyrodyne gained immediate recognition by the award of a contract from the Air Ministry, but the war intervened, and it was not until 1946 that the development of the gyrodyne really commenced. During the intervening period the helicopter became a fully-fledged flying machine incorporating certain features of the gyrodyne, viz., the aerodynamic asymmetry of a single lifting rotor in torque balance with a single non-lifting airscrew; the variation of power distribution between branch transmission systems; and lastly the direct control from foot pedals of the collective pitch of the non-lifting airscrew for effecting control of the aircraft in yaw. All of these gyrodyne features have become standard practice in helicopter design.

Where the gyrodyne differs in principle from the standard form of helicopter is in the azimuth location of the non-lifting airscrew. At first sight this might appear to be a matter of minor importance, any position in azimuth from zero to 360 deg. being as good as any other, and the choice being determined merely by a desire to mount the non-lifting airscrew as far as possible from the axis of the lifting rotor, thereby keeping the power absorbed by the non-lifting airscrew at a minimum, and the power applied to the lifting rotor at a maximum. The gyrodyne, on the contrary, aims at keeping the rotor power as low as possible and utilizes the remainder in the non-lifting airscrew for the useful purpose of forward propulsion. Although part of this remainder is used normally for torque balance in hovering flight, the whole of the remainder is available always as a reserve for vertical climb under abnormal circumstances. A slow rotation of the fuselage in vertical climb can effect a considerable change in power distribution between the airscrew and the rotor. Consequently, vertical climb can be temporarily boosted whenever necessary.

What is a "Gyrodyne"?

According to the British Standard Glossary of Aeronautical Terms, aircraft are classified into two separate categories, "aerodynes" and "aerostats," an aerodyne being a heavier-than-air aircraft. A gyrodyne, therefore, is a kind of gyratory aerodyne. In other words, a gyrodyne is a form of helicopter in which the rotating wings are basically the sole means of sustentation but not of propulsion, the main objective being to keep the power transmitted to the rotor as low as possible, and hereby to provide greater safety in operation. It so happens that the steps taken in the design of this form of helicopter to enhance its safety result also in a higher top speed, though speed is considered of secondary importance to safety. The higher the forward speed, the less proportion of the total power is delivered to the rotor. Hence the main transmission is not so highly stressed at top speed as at slower speeds, thus ensuring a higher factor of safety.

A further safety feature of the present gyrodyne is its low-pitch operation under all conditions of flight and, with its relatively low disc loading, it possesses well-proven qualities of the gyroplane which the helicopter should seek to retain. It is regrettable that present-day helicopters should have sacrificed safety to such a degree that the Parliamentary Secretary of the Ministry of Civil Aviation was obliged recently to refer to the matter in the House of Commons. While we do not entirely agree with the statement made on that occasion, the high-pitch operation of helicopters is a definite source of danger, but it should not be assumed that all helicopters are necessarily dangerous. The gyrodyne, by keeping rotor power, disc loading and pitch as low as possible, increases the margin of safety.

The Gyrodyne Principle

Attempts have been made in the past to discover a method of propulsion for helicopters such that the tip-path plane should remain horizontal in level flight. Probably the nearest approach to the gyrodyne was an arrangement described by Oehmichen, in which translational flight was effected by differential variation of the thrust of a group of airscrews. The use of a single airscrew was discarded, however, because the machine would be unable to hover owing to the unbalanced thrust of the airscrew. The gyrodyne does not attempt to keep the tip-path plane horizontal under all conditions of flight, nor to maintain constant power distribution between rotor and airscrew. The single outboard airscrew maintains torque balance, not only with varying rotor torque, but at zero forward speed, in which case the tip-path plane is inclined backwards, so that the forward thrust of the airscrew is balanced by the backward component of the rotor thrust.

Translational speed is achieved by decreasing this backward inclination of the tip-path plane, and not until a fairly high forward speed has been attained does the tip-path plane assume a horizontal attitude. Beyond this forward speed, of course, the tip-path plane has a slight forward inclination. In other